

July 9, 1997

Ms. Gwen Barunas  
Case Manager  
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Bureau of Federal Case Management  
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RE: L.E. Carpenter Superfund Site, Wharton, New Jersey  
Response to NJDEP and USEPA Comments on the  
*Remedial Action Plan for Phase I - Free Product Recovery*

Dear Ms. Burunas:

In response to the comments from the New Jersey Department of Environmental Protection (NJDEP - April 17, 1997) and the U.S. Environmental Protection Agency (USEPA - May 27, 1997) regarding the Remedial Action Plan for Phase I-Free Product Recovery at the referenced site, RMT, Inc. (RMT) has provided the following additional information:

**NJDEP Comment 1**

According to the work plan, this vapor extraction proposal will remove a greater quantity of product than that original product removal proposal. However, no supporting calculations or assumptions are provided to support this conclusion. The Department wishes to avoid technical arguments at this time, however please note that if this design proves inadequate to accomplish the goal of timely capture and removal of free product the Department will require additional remedial efforts to achieve this goal.

**Response**

Enhanced-fluid recovery (EFR) is an active free product extraction technique. EFR is accomplished by applying a negative pressure (vacuum) at the extraction point. An increased rate of fluid flow toward the extraction point is established as a result of the induced pressure gradient (Bernoulli's Principle) with the fluid flow proportional to the established gradient less the head loss associated with flow through the subsurface media. EFR, because of the induced flow, can recover floating product at a faster rate than a passive recovery system. The system will be closely monitored and the design will be adjusted, if needed, to accomplish the goal of timely capture and removal of free product.

**NJDEP Comment 2**

The work plan states that one of the key elements to successfully applying Enhanced Fluid Recovery (EFR) is to minimize groundwater extraction while maximizing free-product recovery. In addition to the position of the drop pipe within the recovery well, the pumping rate of the free product/groundwater based on the applied vacuum (approximately 22-inches of mercury) and procedures for controlling the water level and flow rates during operation of the extraction system should be determined. The rationale for applying 22-inches of mercury to the individual recovery wells needs to be clarified.

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have comments  
on 8/17/97 wed

### **Response**

As stated in the Remedial Action Plan for Phase 1, each recovery well will be gauged to determine the depth and thickness of free product prior to EFR operations, to maximize freeproduct recovery and to minimize groundwater extraction. Based on the measured depth to free product, the drop pipe will be located initially at the air/free-product interface to skim free product exclusively. When the free product recovery rate slows, as a result of diminished free product thickness in the well, the EFR episode will be interrupted temporarily and the well will be regauged to determine product thickness and depth to water. If necessary, the drop pipe length will be adjusted to optimize free product recovery. In addition, L.E. Carpenter will provide the NJDEP with documentation of the procedures which work best at each location once the program is in-place and operational experience is gained.

The pumping rate of the free product/groundwater from the recovery well will be variable from well to well, because after the free product contained in the well is initially removed, the subsequent extraction rate (free product removal from the formation) is limited by the hydrogeologic properties of the aquifer. Therefore, the flow in the drop pipe will be intermittent and dependent on the formation's capacity to yield the free product. Instead of determining the flow rate of the free product/groundwater, an emphasis will be placed on measuring the amount (in gallons) of free product that is actually removed during each EFR event. The amount of liquid removed during each event will be measured at the disposal/recycling facility when the vacuum truck storage tank is emptied.

Although the vacuum truck will be capable of applying vacuum pressures up to 22 inches of mercury, vacuum pressure applied to the recovery well will be maintained at a minimal level sufficient to allow fluids to be lifted from the well into the vacuum truck (anticipated to range from 4 to 8 inches of mercury based on depth to fluids ranging from 3 to 5 feet below grade). Excess pressure generated by the vacuum truck will be vented using a vacuum relief port.

### **NJDEP Comment 3**

The work plan should discuss the basis for the pumping schedule outlined under Section 3. For example, it seems as though the schedule could be condensed to 6 months as opposed to a year if pumping occurred on a daily basis in the beginning or several times a week for the first month.

### **Response**

As stated in Section 3 of the Remedial Action Plan, the frequency of EFR events will be adjusted depending on the recovery rate of free product after each EFR event. Each individual event will be extended as needed to recover as much readily available product as the formation will yield. Following the initial EFR event, RMT will perform recovery well gauging at 8, 24, 48, 96 and 168 hours to assess the recovery (rebound) rate. If justified, based on the recovery well gauging, EFR will be conducted more frequently than specified in the Plan. As stated in the Plan, the frequency of EFR events will generally decrease over time because recovery rates will slow due to reduced product thicknesses across the site as a result of EFR activities. However, based on the results of the well gauging activities and EFR field logs, L.E. Carpenter will modify the EFR event schedule to include the pumping of 'high yield' recovery wells on an appropriate frequency.



### **USEPA - General Comment 1**

According to the work plan, the free product plume is relatively stable and is present in thicknesses of up to three feet. However, no discussions or calculations are provided to support the conclusions. If the reported free product thicknesses are based on bore product thickness only, this could result in insignificant errors in estimating drainable product volume. The apparent free product, indicated by well bore product thickness, is typically much greater than the actual free product thickness in the surrounding soil. If the reported free product thicknesses are based on adjusted measurements please provide any relevant data and equations used to predict actual product thickness.

### **Response**

The free-product isopach map presented in the Remedial Action Plan (Figure 1) was generated by Roy F. Weston, Inc. (Weston), using apparent free-product measurements obtained from the groundwater monitoring wells in June 1996. Historical data (free-product contour maps) provided by Weston since 1989 indicates that the free-product plume is stable. Since the submittal of the Remedial Action Plan, a more recent evaluation of free product volume has been completed. An updated free product footprint (aerial extent -in sq. feet) was developed using information obtained during the April 1997 monitoring event. The footprint, in conjunction with true free product thickness developed from product bail-down tests completed in August 1995, were utilized to calculate an estimated product volume of 29,640 gallons. This calculation was completed using an assumed effective porosity of 20%. Since volume of recoverable free product is dependent upon many factors, a range of volumes was calculated using generally accepted rates quoted in literature (5 to 60%).

The estimated volume of recoverable free product ranges from 1,500 to 17,800 gallons. These two estimates are based upon utilizing the low end (5%) and high end (60%) for product recovery rates and assuming an estimated product volume of 29,640 gallons. Common recovery rates as presented in literature range from 20 to 30 percent, resulting in recoverable free product volumes estimates of 5,900 to 8,900 gallons. Free product volume calculations are attached.

Literature review indicates that the assumption that the thickness of free-product in the water bearing unit is equal to the free-product thickness in the monitoring well is not necessarily true in nature (Lenhard and Parker, 1990; Farr, Houghtalen, and McWhorter, 1990). For example, Lenhard and Parker state:

"It is well known that actual hydrocarbon volume per unit surface area ("hydrocarbon specific volume") is less than the free-product thickness in a well (van Dam, 1967). DePastrovich *et al.* (1979) proposed that the measured free-product thickness in monitoring wells ("well product thickness") is approximately four times the thickness of the soil zone in which free hydrocarbon is observable ("soil hydrocarbon thickness")."

Subsequent to the DePastrovich work, Hall *et al.* (1984) proposed that hydrocarbon thickness in soils be estimated from well hydrocarbon thickness after applying a porous media dependent correction factor. However, a correction factor was not proposed.

Lenhard and Parker, and Farr, Houghtalen, and McWhorter, both presented methods to estimate free-product volume in the water bearing unit based on free-product thickness in the monitoring well. These methods when applied to specific soils resulted in ratios of free-product thickness in the well to the free-product volume in the water bearing unit of from 3:1 to 20:1. However, the methods require simplifying assumptions: the water bearing unit must be homogeneous, water



levels are at static equilibrium (fluctuations in water levels negate the method), and discontinuous residual free-product is not accounted for. The method also required specific free-product and formation characteristics such as air-organic displacement pressures, organic-water displacement pressures, etc.; characteristics not available for the L.E. Carpenter site. Therefore, these methods can not be applied at the subject site without further investigation.

The distribution of free-product in the subsurface is a function of the free-product characteristics, water and air pressure within the subsurface, and the pore-size distribution of the porous medium. There appears to be no straight forward method to relate free-product thickness in a monitoring well to free-product volume in the water bearing unit per unit area.

L.E. Carpenter understands that the free-product thicknesses in the surrounding soil can be significantly different than those measured in monitoring wells. However, based on the discussion presented above, monitoring well data can be effectively used to estimate of the volume of free-product underlying the subject property as well as and the lateral extent of the plume.

#### **USEPA - General Comment 2**

**The PRP should consider the installation of extraction trenches in the free product plume areas to enhanced recovery and minimize the amount of water extracted. Due to the shallow water table extraction trenches should be seriously considered from both a productivity and cost-effectiveness standpoint as each extraction trench could replace several of the proposed vertical extraction wells. Limiting factors such as large water table fluctuations and the presence of underground utilities should be investigated.**

#### **Response**

During the development of the proposed remedial action plan, L.E. Carpenter evaluated the installation of horizontal trenches within the free-product plume to enhance recovery and minimize the amount of groundwater extracted. However, the option was removed from further consideration for the following reasons:

- Groundwater levels at the subject site fluctuate from approximately ground surface to 6 ft below grade making optimal trench placement difficult. For example, under certain seasonal conditions the free-product layer may be above or below the horizontal recovery pipe in the extraction trench, thus either prohibiting free product removal or increasing the volume of groundwater that would be removed.
- The use of vertical wells will provide a significant cost savings versus installing horizontal trenches. The cost of installing horizontal trenches would be greater do to the cost associated with disposal of a greater quantity of impacted soil.
- Vertical wells provide greater control with regard to maximizing free-product recovery. For instance, the drop pipe used to extract free product can be manually adjusted within the vertical well to maximize free-product recovery. Seasonal groundwater fluctuations will not adversely affect free product removal because the drop pipe can be manually adjusted within the vertical well.



**USEPA - Specific Comment 3**

**Page 4, Section 2.4 Soil Cuttings Well Development Water and Decontamination Water Disposal:**

**"Due to the presence of free product, decontaminating the drilling equipment between wells is not necessary and would add little to no benefit." This statement is incorrect. Contaminated material that adheres to the surface of drilling equipment may be transferred to uncontaminated surface and subsurface soil above the free product contaminated soil. Drilling equipment must be decontaminated between boreholes to prevent cross-contamination.**

**Response**

The recovery wells are being installed in areas that are known to have a free-product layer floating on top of the water table, furthermore the vadose zone above the free product is impacted with the same constituents that are present in the free product. In order to install the recovery wells, the augers must be advanced into the free-product layer and after completing well installation, the augers must be withdrawn upward through the impacted vadose zone. As a result, impacted soil that adheres to the augers must be withdrawn through the vadose zone. Therefore, decontaminating the augers between wells does not appear necessary and should not be required. Drill cuttings will be containerized in drums and securely stored on site until landfill disposal approval is obtained.

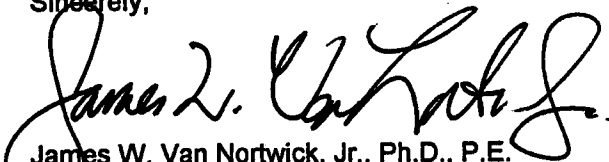
**USEPA - Specific Comment 4**

**Page 11, Section 3.2 Free Product Removal Reporting. Free product thickness contour maps should include predicted actual free product thickness data. Apparent (well bore product) thickness data and predictive methods and/or formulas should be included and discussed in the report.**

**Response**

Although the data collected during the free-product removal activities can only be used to estimate the quantity of free-product remaining at the subject property, the remedial action workplan is designed to actively remove free-product from the site rather than collect additional data to predict and/or model actual free-product thickness data.

Sincerely,



James W. Van Nortwick, Jr., Ph.D., P.E.  
Senior Project Manager

cc: Stephen Cipot - U.S.EPA  
Cristopher Anderson-L.E. Carpenter

Enclosure

**References**

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